

# What is Process Safety Engineering?

Implementing into everyday engineering procedures, a broad-based understanding of the complex interaction of chemical process technology, mechanical and process design, process control, and Process Safety Management Systems (PSMS) and by virtue of knowledge and experience, evaluate an integrated petrochemical process and:

## Identify hazards:

- overpressure/underpressure hazards
- thermal expansion and brittle fracture hazards
- fire and explosion hazards
- dust explosion hazards
- static electricity hazards
- human factors hazards
- chemical and reactive chemistry hazards
- toxic exposure

## Evaluate the risk from those hazards, both qualitatively and quantitatively:

- knowledge of previous incidents that have occurred in the company and industry
- failure mechanisms that could lead to risks being realized
- risk scenarios that should be evaluated
- sufficient and effective hazard controls in place or needed
- analyze the consequences and probabilities of those risk scenarios
- assess the significance of risk posed by those scenarios

## Assist in the identification of and evaluation of cost-effective engineering solutions to reduce or mitigate those risks:

- remove or reduce the hazard through inherently safer solutions
  - simplify the process
  - substitute less hazardous materials for more hazardous materials
  - operate at less hazardous operating conditions
  - reduce inventories
- reduce the likelihood of risks by providing more or better layers of protection
- reduce the consequence of risks by employing mitigating systems
- apply Human Factors principles to reduce the error potential at the interfaces of people with equipment and instrumentation

To successfully perform these functions by being knowledgeable in the following areas:

## Knowledge:

- Engineering Standards and Practices:
  - Legislation and regulations
  - Company engineering practices
  - Industry Standards (API, etc.)
  - Consensus Standards and Codes (ASME, ASTM, NFPA, ANSI, ISA, EN, etc.)
  - Recognized and Generally Accepted Good Engineering Practices (CCPS, etc.)
  - Process Safety Management Systems

- Human Factors:
  - Human-machine concepts
  - Principles of human error reduction
- Process Safety Information:
  - Process Flow Diagrams (PFDs)
  - Piping and Instrumentation Diagram (P&IDs)
  - Mechanical Drawings and plot plans
  - Instrumentation and Electrical Diagrams
  - Electrical Area Classification
  - Facility Siting and Equipment Spacing
  - Relief System Design and Design Basis
  - Material and Energy Balance
  - Materials Envelope Statement/Safe Operating Envelope
  - Properties and Hazards of Materials, including incompatibilities
  - Safety Instrumented Function SIL Target and relevance to installation, inspection and maintenance
  - Buildings blast resistance design basis
  - Fire fighting and associated facilities such as Sewer Design Basis
- Process Hazards Analysis Methodologies:
  - Hazard and Operability study (HAZOP)
  - What-If Analysis
  - Preliminary Hazards Analysis
  - Checklist Analysis
  - Inherent Safety Analysis
  - Critical Task Analysis (CTA)
  - Human Factors Review
  - Pre-Startup Safety Review
  - Failure Mode and Effects Analysis (FMEA)
- Technical Systems Analysis Methodologies:
  - Safety Relief Valve and Flare Header analysis
  - Fire Protection System analysis
  - Safety Instrumented System quantitative analysis
- Risk Analysis and Assessment Methodologies:
  - Fault Tree Analysis
  - Event Tree Analysis
  - Release and Dispersion Analysis
  - Consequence Analysis
  - Qualitative, scenario-based risk assessments
  - Quantitative risk assessments (QRA)
  - Root-cause Incident Investigation techniques
- Decision Analysis Methodologies:
  - Benefit/Cost Analysis
  - Semi-quantitative Risk and Decision Analysis
  - Quantitative Risk and Decision Analysis
  - Evaluating options in the context of ALARP

Typical work activities in Process Safety Engineering include:

### Site Level

- Audit key elements of process safety to ensure processes are being followed and are working as intended
- Ensure proper application of MOC and appropriate hazard analysis and risk assessments are performed on changes
- Confirm proper resolution and closure of recommendations from process safety studies, audits, and incident investigations
- Coordinate and ensure effective execution of hazard and risk assessment studies
- Ensure site personnel are trained and recognize their role in process safety
- Communicate and work with management to ensure leadership and proper emphasis on process safety, including employee participation
- Help prioritize actions to eliminate/mitigate process safety risks
- Ensure that projects fully address process safety in-design and satisfy process safety requirements

### Company/Central Engineering Services Level

- Provide specialist consulting service in safety and fire protection in the design, engineering, construction and operation of chemical plants and refineries
- Provide on-call advice and recommendations on applicability and interpretation of both internal and external guidelines and standards
- Develop new criteria and guidelines
- Monitor additions and changes to codes and standards applicable to company operations
- Actively participate to influence and remain current with new developments and positions taken on updates to existing standards
- Assist in the implementation and improvement of Process Safety Management Systems
- Develop and deliver training and other presentations on Process Safety Management and related subjects
- Develop or assist in the development of new and updated tools for process safety applications and reviews
- Participate in or lead process hazards and other process safety analysis at existing sites and for new projects
- Participate in or lead formal Risk Assessments of existing operations
- Represent the Company in outside professional process safety organizations (CCPS, EPSC, IPSC, etc.), research consortia (MKOPSC, Wharton, etc.), and process safety committees of trade organizations (API, ACC, TCC, SOCMA, etc.)
- Develop and maintain contacts with other companies to remain abreast of Industry Best Practices
- Provide Process Safety advice related to ongoing site risk management